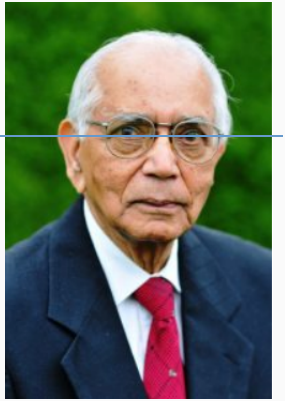
Mathematical Statistics II

STA2212H S LEC0101



Week 12

April 4 2023

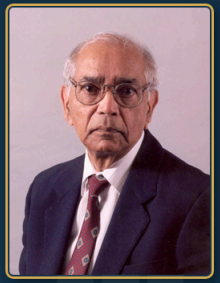
International Prize in Statistics

Eminent Statistician C.R. Rao Awarded 2023 International Prize in Statistics

C.R. Rao, a professor whose work more than 75 years ago continues to exert a profound influence on science, has been awarded the 2023 International Prize in Statistics.

In his remarkable 1945 paper published in the *Bulletin of the Calcutta Mathematical Society*, Calyampudi Radhakrishna (C.R.) Rao demonstrated three fundamental results that paved the way for the modern field of statistics and provided statistical tools heavily used in science today.

Read more →



1945: Cramér-Rao lower bound; Rao-Blackwell theorem

2017: David R. Cox
2019: Bradley Efron
2021: Nan Laird

Upcoming

- April 6 3.30 – 4.30 Stats Dept Seminar Room 9014
  Ramsés Mena, UNAM
  Random probability measures via dependent stick-breaking priors

- April 11 9.30 – 12.30 Hydro Room 9016
  Informal discussion of large language models Register here

- April 27 9.45 – 5.05 Hydro Room 9014/6
  Graduate Student Research Day

- Likelihood estimation: maximum likelihood estimates, consistency, asymptotic normality, delta-method, optimization (N-R, E-M, Q-N), Kullback-Leibler divergence, model misspecification, Godambe information, profile likelihood function, nonparametric MLE, empirical cdf Jan 10, 17

- Bayesian inference: prior distribution, posterior distribution, conjugate priors, flat priors, Jeffreys' invariant prior, multi-parameter problems, interpretation of prior and posterior distributions, normal approximation to posterior Jan 17, 24

- Optimality in estimation: asymptotic efficiency, Cramer-Rao lower bound, minumum variance unbiased estimators, finite-sample optimality, loss functions, risk functions, Bayes risk, admissibility, minimax, Bayesian hierarchical models, shrinkage estimation Jan 24, Feb 7

... Summary

- Interval estimation: exact confidence intervals, approximate confidence intervals, pivotal quantities, confidence regions, Bayesian credible intervals, highest posterior density intervals, profile likelihood intervals, nonparametric confidence bands – pointwise and simultaneous Feb 7, Feb 14
- Hypothesis testing: null and alternative, test function/statistic, rejection/critical region, type 1 and type 2 error, power and size Feb 14, 28
- Test statistics: Neyman-Pearson lemma, Wald, score/Rao, likelihood-ratio statistic, classical two-sample tests of means and proportions, nonparametric tests – sign, permutation, goodness-of-fit Feb 28
- Significance tests: p-values, two-sided and one-sided, interpretation of statistical significance, interpretation of p-values Mar 7, 14

... Summary

- Diagnostic testing: sensitivity and specificity, receiver-operating-characteristic (ROC),
- multiple testing: adjustment for selection, Bonferroni, Benjamini-Hochberg, false discovery rate control

Mar 7, 14

- Robust regression: M-estimates, estimating equations, quantile regression
- saddlepoint approximation: r^* approximation

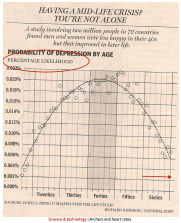
Mar 14

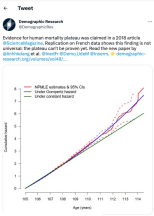
- Causality: potential outcomes, counterfactuals, confounding, Simpson's paradox, observational studies, randomization, no un-measured confounding, Bradford-Hill criteria average treatment effect, causal effect, association, causal regression, directed acyclic graphs

Mar 21, 28

- Classification: $0-1$ loss, Bayes classifier, Naive Bayes, linear and quadratic discriminant analysis, logistic regression, K-nearest neighbours, empirical error rate, test error rate, cross-validation, over-fitting, double-descent

Mar 28





Science & technology / Archers and heart rates

How to measure how stress affects athletes' performance

Pick a sport where they don't move much, and study skin flushing

Jan 19th 2023

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HEALTH

A New Turn in the Fight Over Masks

A crucial pandemic question is deceptively hard to answer.

By Yasmin Tayag

N Give me an example from a recent news article of Simpson's paradox

‹ 2 / 2

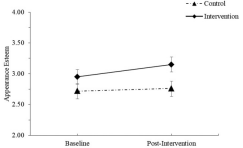
One example of Simpson's paradox in a recent news article involves the gender pay gap in the tech industry.

In 2020, a study by Hired Inc. found that on average, women in the tech industry earn 3% less than men with the same job title and level of experience. However, when the data was broken down by individual job titles, it was found that in 63% of the positions studied, women earned more than men.

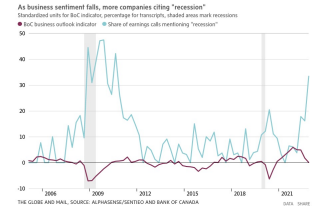
This is a clear example of Simpson's paradox, where a trend appears in one direction when the data is looked at as a whole, but is reversed when the data is broken down into smaller subgroups. In this case, the overall gender pay gap in the tech industry was 3%, but when the data was separated by job title, it was revealed that women actually earned more than men in many positions. This suggests that there may be other factors at play, such as the types of jobs women and men are choosing within the industry.

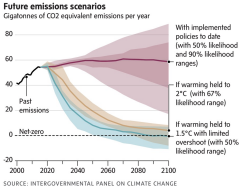
Figure 2

Effect of Reducing Social Media Use on Levels of Appearance Esteem by Condition



Note. Error bars represent standard errors.





- likelihood, selective reporting, risk communication, extreme-value modelling

- correlation and regression, adjusting for confounders (not), confusing graphics

- population vs individual risk, designed exp't w interaction, modelling uncertainty